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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/588,495	08/04/2006	Frank Forster	4001-1225	9223

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EXAMINER	
HENSON, MISCHITA L	
ART UNIT	**PAPER NUMBER**
2857	

NOTIFICATION DATE	DELIVERY MODE
09/29/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

DocketingDept@young-thompson.com

Office Action Summary	Application No.	Applicant(s)	
	10/588,495	FORSTER, FRANK	
	Examiner	Art Unit	
	Mi'schita' Henson	2857	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 July 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,5,6 and 10-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,5,6 and 10-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02 August 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

This action is responsive to the communication filed July 23, 2010. Claims 1, 5 and 10 have been amended. Claims 1, 3, 5-6 and 10-12 are pending.

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on July 23, 2010 has been entered.

Claim Objections

2. Claim 5 is objected to because of the following informalities:

Claim 5 lines 13-14 recite “the object (2) are on a basis of”, Examiner suggests --the object (2) on a basis of--.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 5-6 are rejected under 35 U.S.C. 102(b) as being anticipated by Geng in US Patent 6,028,672.

Regarding claim 5, Geng teaches:

A method for determining spatial co-ordinates of an object(s) (see three-dimensional surface profile measurement method, Abstract), comprising:

- projecting a pattern (4) with known projection data onto an object (2) (see a projected rainbow color pattern, column 3 lines 44-47; see also see spatially varying color pattern, column 4 lines 52-53 and Fig. 9; see also spatially varying wavelength illumination, column 3 lines 34-36 and column 9 lines 17-18) by using a projector (see light projector, column 4 lines 13-16, column 6 lines 42-54, Figs. 1-2 and 9-10);

- creating an object image (8) with aid of a camera (6) (see captured images, column 4 lines 30-55, column 5 lines 24-28; see also "...a pair of CCD cameras...The images, which contain both intensity and color...", column 2 lines 17-25, column 6 lines 59-61 and Fig. 1);

- determining the spatial co-ordinates from the known projection data (see three-dimensional surface profile measurement method, Abstract) in a data processing unit (7) (see host computer, column 4 lines 25-26, column 5 lines 66-67 and Fig. 1) using a structured light approach, in which the spatial co-ordinates of the object (2) are determined using a known distance between the projector (s) and the camera (6) (see structured light, column 2 lines 7-10 and column 4 lines 57-58; see also baseline, column 2 lines 16-17 and column 7 lines 21-22);

- recording with aid of a further camera (6) a further object image (9) (see "...a pair of CCD cameras...The images, which contain both intensity and color...", column 2 lines 17-25, column 6 lines 59-61 and Fig. 1) and that, if the spatial co-ordinates are

determined incorrectly, determining additional spatial co-ordinates of the object (2) are on a basis of the projection data and one of the object images (8, 9) by searching for corresponding image points (S_l, S_r) in the object images (8, 9) (see Two Complementary Stereo Matching Schemes, column 7 line 15 - column 8 line 48) and a subsequent triangulation (see triangulation algorithm/principle, Abstract, column 3 lines 40-41 and Fig. 1; see also active triangulation, column 2 lines 9-50).

Regarding claim 6, Geng teaches the limitations of claim 5 as indicated above. Further, Geng teaches:

The method as claimed in claim 5, wherein corresponding pixels (S_l, S_r) are searched for along epipolar lines (16, 17) (see epipolar line, column 8 lines 20-48 and Fig. 5).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 3 and 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Geng in US Patent 6,028,672, in view of Pettersen et al. 2002/0048027.

Regarding claim 1, Geng teaches:

A device for determining spatial co-ordinates of an object(s), comprising:

a projector (3) which projects onto the object (2) (see light projector, column 4 lines 13-16, column 6 lines 42-54, Figs. 1-2 and 9-10; see object, column 4 lines 18-20 and Figs. 1-2 and 9-10) a pattern (4) with known projection data (see spatially varying color pattern, column 4 lines 52-53 and Fig. 9; see also spatially varying wavelength illumination, column 3 lines 34-36 and column 9 lines 17-18);

a camera (6) which creates an object image (8) of the pattern (4) projected onto the object (2) (see "...a pair of CCD cameras...The images, which contain both intensity and color...", column 2 lines 17-25, column 6 lines 59-61 and Fig. 1), the pattern (4) containing encoded projection data (see "simple and elegant way to encode", column 4 lines 52-56; see also encodes, column 7 lines 34-38);

a data processing unit (7) (see host computer, column 4 lines 25-26, column 5 lines 66-67 and Fig. 1) connected downstream from the camera (6), which determines spatial co-ordinates of the object (2) from the object image (8) and the known projection data (see three-dimensional surface profile measurement, Abstract) using a structured light approach, in which the spatial co-ordinates of the object (2) are determined using a known distance between the projector (s) and the camera (6) (see structured light, column 2 lines 7-10 and column 4 lines 57-58; see also baseline, column 2 lines 16-17 and column 7 lines 21-22); and

at least one further camera (6) (see "...a pair of CCD cameras...The images, which contain both intensity and color...", column 2 lines 17-25, column 6 lines 59-61 and Fig. 1) which creates a further object image (9) and the data processing unit (7) determines additional spatial co-ordinates of the object (2) from the object images (8, 9)

by a triangulation method (see triangulation algorithm/principle, Abstract, column 3 lines 40-41 and Fig. 1; see also active triangulation, column 2 lines 9-50).

Geng differs from the claimed invention in that it does not explicitly teach redundant encoded projection data and restricting the search for corresponding image points to problem areas in which an evaluation of the pattern images only produce an erroneous result.

Pettersen et al. teaches a method and system, using cameras, for determination of relative position and/or orientation of objects by projecting a pattern (Abstract, [0001]-[0008] and Figs. 2, 5 & 6). Further, Pettersen et al. teaches "The method of calculation is bases on minimizing errors (least squares method) such that the redundant information is used" (i.e. redundant encoded projection data and restricting the search for corresponding image points to problem areas in which an evaluation of the pattern images only produce an erroneous result, [0025] and Fig. 2]). Since Pettersen et al. teaches the redundant data is used to minimize errors, it would have been obvious to one of ordinary skill in the art to search the redundant information for corresponding image points to problem areas in which an evaluation of the pattern images produces an erroneous result in order to correct the result, thus minimizing errors.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have combined the teachings of Pettersen et al. with Geng because Pettersen et al. teaches the principle of coordinate determination from the imaging of a common point in two or more cameras and a means for coordinate measurement that gives full flexibility with respect to the number of cameras and other

features ([0009]-[0014] and [0021]-[0022]), thereby improving the flexibility of the system.

Regarding claim 3, Geng and Pettersen et al. teach the limitations of claim 1 as indicated above. Further, Geng teaches:

The device as claimed in claim 1, wherein epipolar lines (16, 17) pass through a plurality of marks of the pattern (4) (see epipolar line, column 8 lines 20-48 and Fig. 5).

Regarding claim 10, Geng teaches:

A method for determining spatial co-ordinates of an object(s) (see three-dimensional surface profile measurement method, Abstract), comprising:

- projecting a pattern (4) with known projection data onto an object (2) (see a projected rainbow color pattern, column 3 lines 44-47; see also see spatially varying color pattern, column 4 lines 52-53 and Fig. 9; see also spatially varying wavelength illumination, column 3 lines 34-36 and column 9 lines 17-18) by using a projector (3) (see light projector, column 4 lines 13-16, column 6 lines 42-54, Figs. 1-2 and 9-10);

- creating an object image (8) with aid of a camera (6) (see captured images, column 4 lines 30-55, column 5 lines 24-28; see also "...a pair of CCD cameras...The images, which contain both intensity and color...", column 2 lines 17-25, column 6 lines 59-61 and Fig. 1);

- determining the spatial co-ordinates from the known projection data (see three-dimensional surface profile measurement method, Abstract) in a data processing unit (7) (see host computer, column 4 lines 25-26, column 5 lines 66-67 and Fig. 1) using a structured light approach, in which the spatial co-ordinates of the object (2) are

determined using a known distance between the projector (s) and the camera (6) (see structured light, column 2 lines 7-10 and column 4 lines 57-58; see also baseline, column 2 lines 16-17 and column 7 lines 21-22);

- recording with aid of a further camera (6) a further object image (9) (see "...a pair of CCD cameras...The images, which contain both intensity and color...", column 2 lines 17-25, column 6 lines 59-61 and Fig. 1) and that, if the spatial co-ordinates are determined incorrectly, additional spatial co-ordinates of the object (2) are determined on a basis of the projection data and one of the object images (8, 9) by searching for corresponding image points (S_l, S_r) in the object images (8, 9) (see Two Complementary Stereo Matching Schemes, column 7 line 15 - column 8 line 48) and a subsequent triangulation (see triangulation algorithm/principle, Abstract, column 3 lines 40-41 and Fig. 1; see also active triangulation, column 2 lines 9-50).

Further, Geng teaches the pattern (4) contains encoded projection data (see "simple and elegant way to encode", column 4 lines 52-56; see also encodes, column 7 lines 34-38). Geng differs from the claimed invention in that it does not explicitly teach redundant encoded projection data and restricting the search for corresponding image points to problem areas in which an evaluation of the pattern images only produce an erroneous result.

Pettersen et al. teaches a method and system, using cameras, for determination of relative position and/or orientation of objects by projecting a pattern (Abstract, [0001]-[0008] and Figs. 2, 5 & 6). Further, Pettersen et al. teaches "The method of calculation is bases on minimizing errors (least squares method) such that the redundant

information is used" (i.e. redundant encoded projection data and restricting the search for corresponding image points to problem areas in which an evaluation of the pattern images only produce an erroneous result, [0025] and Fig. 2]). Since Pettersen et al. teaches the redundant data is used to minimize errors, it would have been obvious to one of ordinary skill in the art to search the redundant information for corresponding image points to problem areas in which an evaluation of the pattern images produces an erroneous result in order to correct the result, thus minimizing errors.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have combined the teachings of Pettersen et al. with Geng because Pettersen et al. teaches the principle of coordinate determination from the imaging of a common point in two or more cameras and a means for coordinate measurement that gives full flexibility with respect to the number of cameras and other features ([0009]-[0014] and [0021]-[0022]), thereby improving the flexibility of the system.

Regarding claim 11, Geng teaches the limitations of claim 10 as indicated above. Further, Geng teaches:

The method as claimed in claim 10, wherein corresponding pixels (S_l, S_r) are searched for along epipolar lines (16, 17) (see epipolar line, column 8 lines 20-48 and Fig. 5).

Regarding claim 12, Geng and Pettersen et al. teach the limitations of claim 10 as indicated above. Further, Geng teaches:

5. The method as claimed in claim 10, wherein epipolar lines (16, 17) pass through a plurality of marks of the pattern (4) (see epipolar line, column 8 lines 20-48 and Fig. 5).

Response to Arguments

6. Applicant's arguments filed July 23, 2010 have been fully considered but they are not persuasive.

Applicant argues:

> ...However, GENG fails to use a structured light approach, in which the spatial co-ordinates of the object are determined based on the distance between the projector and a camera. GENG further fails to teach a method, in which additional spatial co-ordinates of the object are determined, if the spatial coordinates are determined incorrectly.
>
> According to GENG, the color based stereo matching method and the intensity based stereo matching method are not used if one or the other method fails but the appropriate method is chosen before either method is applied by calculating an overall score as disclosed at column 10, lines 8 to 17. Thus, according to GENG, the color based stereo matching method and the intensity based stereo matching methods are used as alternatives depending on the structure of the object's surface.

Geng teaches "our system uses active structured light to illuminate the scene" (i.e. a structured light approach, column 4 lines 57-58; see also column 2 lines7-10) and "The essence of stereo matching is, given a point in one image, to find a corresponding point in another image, such that two points are the projections of the same physical point in space. <u>*Once the corresponding pixels are found in both images*</u>, and the geometric parameters of camera and <u>*base line*</u> are known, the triangulation can be performed in a straightforward fashion to find the 3D range. The Rainbow Stereo 3D camera has a high degree of parallelism in which two complementary stereo matching schemes, namely color matching and intensity matching, can be synergistically combined to provide accurate and reliable high speed 3D measurement for a wide

range of application scenario" (emphasis added, column 7 lines 17-23; baseline is the distance between a camera and the projector).

Applicant argues:

> Independent claims 1 and 10 are directed to a device and a method in which a pattern containing redundant encoded projection data is projected onto the object. Redundant encoded data are data that allow for the detection of errors (specification at page 6, last sentence). If an error is detected while performing the structured light approach, the process switches to a triangulation process, in which object images from both cameras are used for triangulating the spatial co-ordinates of the object.

Regarding claim 10, in response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., redundant encoded data) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Regarding claim 1, Geng and Pettersen et al. teaches the limitations of claim 1 as indicated above.

Applicant argues:

> The term redundant information refers therefore to the fact that the system of equation is over-determined and not to the redundant encoded projection pattern.
>
> In addition, PETTERSEN et al. do not disclose the projection of any pattern at all.
>
> One of ordinary skill and creativity would thus not produce a claimed embodiment of the present invention from a knowledge of GENG and PETTERSEN et al. A *prima facie* case of unpatentability has thus not been made.

In response to applicant's argument that "One of ordinary skill and creativity would thus not produce a claimed embodiment of the present invention from a knowledge of GENG and PETTERSEN et al.", the test for obviousness is not whether

the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981).

Geng teaches “The Rainbow Stereo 3D camera is based on a novel approach to producing a continuous spatially varying wavelength (rainbow-like color) illumination of the scene. Two color CCD cameras or two locations of a camera separated by a baseline distance are used to capture stereo pair images of the scene at camera's frame rate. The 3D depth values are calculated using triangulation principle by finding pixels corresponding to a common color feature in both images” (column 3 lines 34-42 and Figs. 1-2 (e.g. including projection of a pattern).

Pettersen et al. teaches “determination of relative position and/or orientation of a number of points or geometrical objects... based on the use of one or more cameras based on electro-optical sensors, in combination with permanently mounted light sources, projected light spots, illuminated reflectors, or probing tools having light sources or reflectors attached thereto” (Abstract) wherein “redundant ***information*** is used” (emphasis added, [0024]), e.g. redundant data).

Therefore, the Examiner maintains that Geng and Pettersen et al. teaches the limitations of claims 1, 3, 5-6 and 10-12 as indicated above.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

Huang et al. in US Publication 2007/0115484 teaches:

> [0005] Structured light techniques, sometimes referred to as ranging systems, utilize various coding methods that employ multiple coding patterns to measure 3D objects quickly without traditional scanning. Known structured light techniques tend to use algorithms that are much simpler than those used by stereovision techniques, and thus better suited for real-time applications. ***Two basic structured light approaches are known for 3D shape measurement***. ***The first approach uses a single pattern, typically a color light pattern generated digitally and projected using a projector***. Since the first structured light approach uses color to code the patterns, the shape acquisition result is affected to varying degrees by variations in an object's surface color. In general, the more patterns used in a structured light system for shape measurement, the better the accuracy that can be achieved.
>
> [0006] ***The second structured light approach for real-time 3D shape acquisition and measurement uses multiple binary-coded patterns, the projection of which is rapidly switched so that the pattern is captured in a cycle implemented in a relatively short period***. Until recently, spatial resolution using such multiple-coded pattern techniques has been limited because stripe width is required to be larger than a single pixel. Moreover, such structured light techniques require that the patterns be switched by repeated loading to the projector, which limits switching speeds and therefore the speed of shape acquisition and processing. A method and apparatus for 3D surface contouring using a digital video projection system, i.e., a structured light system, is described in detail in U.S. Pat. No. 6,438,272 (the '272 patent), commonly owned and incorporated by reference in its entirety herein. (emphasis added).

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mi'schita' Henson whose telephone number is (571) 270-3944. The examiner can normally be reached on Monday - Thursday 7:30 a.m. - 4:00 p.m. EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Drew Dunn can be reached on (571) 272-2312. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

09/19/10
/Mi'schita' Henson/
Examiner, Art Unit 2857

Drew A. Dunn
/Drew A. Dunn/
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